

OCS-A
0501



MASS
USA

VINEYARD WIND

Draft Construction and Operations Plan

Volume III Text

Vineyard Wind Project

June 3, 2020

Submitted by

Vineyard Wind LLC
700 Pleasant Street, Suite 510
New Bedford, Massachusetts 02740

Submitted to

Bureau of Ocean Energy Management
45600 Woodland Road
Sterling, Virginia 20166

Prepared by

Epsilon Associates, Inc.
3 Mill & Main Place, Suite 250
Maynard, Massachusetts 01754

Draft Construction and Operations Plan

Volume III Text

Vineyard Wind Project

Submitted to:

BUREAU OF OCEAN ENERGY MANAGEMENT
45600 Woodland Rd
Sterling, VA 20166

Submitted by:

VINEYARD WIND LLC
700 Pleasant Street, Suite 510
New Bedford, MA 02740

Prepared by:

EPSILON ASSOCIATES, INC.
3 Mill & Main Place, Suite 250
Maynard, MA 01754

In Association with:

Baird & Associates
Biodiversity Research Institute
C2Wind
Capitol Air Space Group
Clarendon Hill Consulting
Ecology and Environment
Foley Hoag
Geo SubSea LLC
Gray & Pape

JASCO Applied Sciences
Morgan, Lewis & Bockius LLP
Public Archaeology Laboratory, Inc.
RPS
Saratoga Associates
Swanson Environmental Associates
Wood Thilsted Partners Ltd
WSP

June 3, 2020

Table of Contents

TABLE OF CONTENTS

1.0	APPLICANT'S PURPOSE AND NEED	1-1
2.0	PROJECT SUMMARY	2-1
2.1	Design Envelope/Phasing	2-2
2.2	Construction and Installation	2-4
2.2.1	Offshore Activities and Facilities	2-4
2.2.1.1	Wind Turbine Generators	2-4
2.2.1.2	WTG Foundations	2-6
2.2.1.3	Electrical Service Platforms (ESPs)	2-7
2.2.1.4	Inter-array Cables	2-7
2.2.1.5	Offshore Export Cables	2-7
2.2.2	Onshore Activities and Facilities	2-8
2.2.2.1	Landfall Site and Onshore Export Cable Route	2-8
2.2.2.2	Onshore Substation	2-9
2.2.2.3	Port Facilities	2-10
2.3	Operations and Maintenance	2-10
2.3.1	Offshore Activities and Facilities	2-10
2.3.2	Onshore Activities and Facilities	2-11
2.4	Decommissioning	2-11
2.4.1	Offshore Activities and Facilities	2-11
2.4.2	Onshore Activities and Facilities	2-13
3.0	PROJECT EVOLUTION	3-1
3.1	Introduction	3-1
3.2	WTG Selection	3-1
3.3	WTG Foundations	3-2
3.4	Wind Development Area and WTG Layout	3-5
3.5	Electrical Service Platform	3-6
3.6	Export Cable	3-6
3.7	Inter-array Cables	3-7
3.8	Interconnection Points and Cable Routes	3-8
3.9	Landfall Sites	3-10
3.10	Transmission Cables	3-12
3.11	Transmission Voltage	3-13
3.12	Cable Installation Techniques	3-13
3.13	Project Schedule	3-13
4.0	SUMMARY OF POTENTIAL BENEFITS, IMPACTS, AND MITIGATION MEASURES	4-1
4.1	Project Benefits	4-1
4.1.1	Energy Reliability Benefits	4-1
4.1.2	Economic Benefits	4-2
4.1.3	Environmental Benefits	4-4

TABLE OF CONTENTS (Continued)

4.2	Summary of Potential Impacts and Avoidance, Minimization, and Mitigation Measures	4-5
5.0	PHYSICAL RESOURCES	5-1
5.1	Air Quality	5-1
5.1.1	Description of the Affected Environment	5-1
5.1.2	Potential Impacts of the Project	5-6
5.1.2.1	Construction and Installation	5-8
5.1.2.1.1	Description of Potential Impacts	5-8
5.1.2.1.2	Avoidance, Minimization, and Mitigation Measures	5-10
5.1.2.1.3	Summary	5-14
5.1.2.2	Operations and Maintenance	5-15
5.1.2.2.1	Description of Impacts	5-15
5.1.2.2.2	Avoidance, Minimization, and Mitigation Measures	5-17
5.1.2.2.3	Summary	5-17
5.1.2.3	Decommissioning	5-17
5.1.2.3.1	Description of Impacts	5-17
5.1.2.3.2	Avoidance, Minimization, and Mitigation Measures	5-18
5.2	Water Quality	5-18
5.2.1	Description of the Affected Environment	5-19
5.2.2	Potential Impacts of the Project	5-28
5.2.2.1	Construction and Installation	5-29
5.2.2.1.1	Pile Driving for Wind Turbine Generator (“WTG”) and Electrical Service Platform (“ESP”) Foundation Installation	5-29
5.2.2.1.2	Cable Installation in Marine Waters	5-29
5.2.2.1.3	Impact of Horizontal Directional Drilling at Cable Landfall	5-50
5.2.2.1.4	Scour Protection Installation	5-50
5.2.2.1.5	Routine Releases from Vessels	5-51
5.2.2.1.6	Avoidance, Minimization, and Mitigation Measures	5-51
5.2.2.1.7	Summary	5-52
5.2.2.2	Operations and Maintenance	5-53
5.2.2.2.1	Routine Releases from Vessels	5-53
5.2.2.2.2	Avoidance, Minimization, and Mitigation Measures	5-53
5.2.2.3	Decommissioning	5-53

TABLE OF CONTENTS (Continued)

5.3	Geology	5-53
5.3.1	Description of the Affected Environment	5-53
5.3.2	Potential Impacts of the Project	5-57
5.3.2.1	Construction and Installation	5-58
5.3.2.1.1	Pile- Driving for WTG and ESP Foundations	5-58
5.3.2.1.2	Scour Protection	5-58
5.3.2.1.3	Cable Installation	5-58
5.3.2.1.4	Cable Protection	5-59
5.3.2.1.5	Horizontal Directional Drilling	5-59
5.3.2.1.6	Avoidance, Minimization, and Mitigation Measures	5-60
5.3.2.1.7	Summary of Impacts	5-60
5.3.2.2	Operations and Maintenance	5-61
5.3.2.2.1	Cable Reburial	5-61
5.3.2.2.2	Cable Protection	5-61
5.3.2.2.3	Avoidance, Minimization, and Mitigation Measures	5-61
5.3.2.2.4	Summary	5-61
5.3.2.3	Decommissioning	5-62
6.0	BIOLOGICAL RESOURCES	6-1
6.1	Terrestrial Fauna Including Inland Birds	6-1
6.1.1	Description of the Affected Environment	6-1
6.1.1.1	Terrestrial Habitats	6-1
6.1.1.2	Terrestrial Fauna including Inland Birds	6-6
6.1.2	Potential Impacts of the Project	6-22
6.1.2.1	Construction and Installation	6-23
6.1.2.1.1	Temporary Habitat Alteration	6-23
6.1.2.1.2	Noise and Vibration	6-24
6.1.2.1.3	Direct Mortality	6-24
6.1.2.1.4	Loss or Alteration of Habitat	6-24
6.1.2.1.5	Avoidance, Minimization, and Mitigation Measures	6-25
6.1.2.1.6	Summary	6-25
6.1.2.2	Operations and Maintenance	6-26
6.1.2.2.1	Temporary Disturbance by Noise	6-26
6.1.2.2.2	Avoidance, Minimization, and Mitigation Measures	6-26
6.1.3	Decommissioning	6-26

TABLE OF CONTENTS (Continued)

6.2	Coastal and Marine Birds	6-27
6.2.1	Description of the Affected Environment	6-27
6.2.1.1	Overview	6-27
6.2.1.2	Definition of Exposure to the WDA	6-27
6.2.1.3	Coastal Birds	6-29
6.2.1.3.1	Shorebirds	6-29
6.2.1.3.2	Waterbirds	6-30
6.2.1.3.3	Waterfowl	6-31
6.2.1.3.4	Raptors (non-eagle)	6-31
6.2.1.3.5	Songbirds	6-33
6.2.1.4	Marine Birds	6-34
6.2.1.4.1	Loons and Grebes	6-34
6.2.1.4.2	Seaducks	6-35
6.2.1.4.3	Shearwaters, Petrels, Storm-Petrels	6-35
6.2.1.4.4	Gannets and Cormorants	6-36
6.2.1.4.5	Gulls and Jaegers	6-36
6.2.1.4.6	Terns	6-37
6.2.1.4.7	Auks	6-37
6.2.1.5	Federally-Listed Species	6-40
6.2.1.5.1	Roseate Tern	6-40
6.2.1.5.2	Piping Plover	6-43
6.2.1.5.3	Red Knot	6-45
6.2.1.5.4	Bald and Golden Eagle	6-46
6.2.2	Potential Impacts of the Project	6-48
6.2.2.1	Construction and Installation	6-50
6.2.2.1.1	Potential Direct and Indirect Impacts of Construction	6-50
6.2.2.1.2	Avoidance, Minimization, and Mitigation Measures	6-53
6.2.2.2	Operations and Maintenance	6-56
6.2.2.2.1	Potential Direct Impacts of Operations and Maintenance	6-57
6.2.2.2.2	Potential Indirect Impacts of Operations and Maintenance	6-66
6.2.2.2.3	Avoidance, Minimization, and Mitigation Measures	6-71
6.2.2.3	Decommissioning	6-74
6.2.2.4	Summary of Findings	6-74
6.2.2.4.1	Coastal and Marine Birds	6-74
6.2.2.4.2	Federally-Listed Species	6-74

TABLE OF CONTENTS (Continued)

6.3	Bats	6-75
6.3.1	Description of the Affected Environment	6-75
6.3.1.1	Cave-hibernating and Migratory Tree Bats	6-76
6.3.1.1.1	Onshore Project Area	6-76
6.3.1.1.2	Offshore Project Area	6-77
6.3.1.2	Federally-Listed Species	6-79
6.3.1.2.1	Onshore Project Area	6-80
6.3.1.2.2	Offshore Project Area	6-80
6.3.2	Potential Impacts of the Project	6-80
6.3.2.1	Construction and Installation	6-81
6.3.2.1.1	Potential Attraction of Bats to Construction Activities in the Offshore Project Area	6-81
6.3.2.1.2	Avoidance, Minimization, and Mitigation Measures	6-81
6.3.2.2	Operations and Maintenance	6-82
6.3.2.2.1	Potential collision of bats with WTGs	6-82
6.3.2.2.2	Avoidance, Minimization, and Mitigation Measures	6-82
6.3.2.3	Decommissioning	6-82
6.4	Coastal Habitats	6-82
6.4.1	Description of the Affected Environment	6-83
6.4.2	Potential Impacts of the Project	6-84
6.4.2.1	Construction and Installation	6-84
6.4.2.1.1	Direct Alteration of Coastal Habitat	6-84
6.4.2.1.2	Avoidance, Minimization, and Mitigation Measures	6-86
6.4.2.1.3	Summary	6-86
6.4.2.2	Operations and Maintenance	6-86
6.4.2.2.1	Direct Alteration of Coastal Habitat	6-86
6.4.2.3	Decommissioning	6-87
6.5	Benthic Resources	6-87
6.5.1	Description of the Affected Environment	6-87
6.5.1.1	Benthic Habitat (hard bottoms, living bottoms) in WDA	6-87
6.5.1.2	Benthic Epifauna, Infauna and Macrofauna in WDA	6-88
6.5.1.3	Benthic Habitat (hard bottoms, living bottoms) Along Offshore Export Cable Corridor	6-98
6.5.1.4	Benthic Epifauna, Infauna and Macrofauna Along Offshore Export Cable Corridor	6-102

TABLE OF CONTENTS (Continued)

6.5.2	Potential Impacts of the Project	6-106
6.5.2.1	Construction and Installation	6-106
6.5.2.1.1	Wind Turbine Generator (“WTG”) and Electrical Service Platform (“ESP”) Foundation Installation	6-106
6.5.2.1.2	Scour Protection and Cable Protection Installation	6-107
6.5.2.1.3	Cable Installation	6-108
6.5.2.1.4	Dredging	6-114
6.5.2.1.5	Avoidance, Minimization, and Mitigation Measures	6-117
6.5.2.1.6	Summary of Impacts	6-117
6.5.2.2	Operations and Maintenance	6-118
6.5.2.2.1	WTG and ESP Foundations	6-118
6.5.2.2.2	Cable Maintenance	6-119
6.5.2.2.3	Other Impacts	6-119
6.5.2.2.4	Avoidance, Minimization, and Mitigation Measures	6-120
6.5.2.2.5	Summary of Impacts	6-120
6.5.2.3	Decommissioning	6-120
6.5.2.3.1	Overall Impacts	6-120
6.5.2.3.2	Avoidance, Minimization, and Mitigation Measures	6-121
6.6	Finfish and Invertebrates	6-121
6.6.1	Description of the Affected Environment	6-121
6.6.1.1	Finfish	6-123
6.6.1.2	Invertebrates	6-133
6.6.1.3	Essential Fish Habitat	6-139
6.6.2	Potential Impacts of the Project	6-139
6.6.2.1	Construction and Installation	6-139
6.6.2.1.1	Habitat Loss or Alteration	6-139
6.6.2.1.2	Increased Noise	6-144
6.6.2.1.3	Avoidance, Minimization, and Mitigation Measures	6-147
6.6.2.1.4	Summary	6-148
6.6.2.2	Operations and Maintenance	6-149
6.6.2.2.1	Habitat Changes, Artificial Reefs, and Fish Attracting Devices	6-149
6.6.2.2.2	Increased Noise	6-150
6.6.2.2.3	Electromagnetic Fields	6-151

TABLE OF CONTENTS (Continued)

	6.6.2.2.4	Cable Repair	6-151
	6.6.2.2.5	Avoidance, Minimization, and Mitigation Measures	6-152
	6.6.2.2.6	Summary	6-152
	6.6.2.3	Decommissioning	6-152
	6.6.2.3.1	Overall Impacts	6-152
	6.6.2.3.2	Avoidance, Minimization, and Mitigation Measures	6-153
6.7		Marine Mammals	6-153
	6.7.1	Description of the Affected Environment	6-153
	6.7.1.1	Overview	6-153
	6.7.1.2	Threatened and Endangered Marine Mammals	6-160
	6.7.1.3	Non-ESA Listed Marine Mammals	6-173
	6.7.2	Potential Project Impacts	6-189
	6.7.2.1	Construction and Installation	6-196
	6.7.2.1.1	Noise from Construction and Installation	6-196
	6.7.2.1.2	Vessel Traffic	6-205
	6.7.2.1.3	Avoidance, Minimization, and Mitigation Options	6-206
	6.7.2.2	Operations and Maintenance	6-209
	6.7.2.2.1	Noise from Operations and Maintenance	6-209
	6.7.2.2.2	Vessel Traffic	6-211
	6.7.2.2.3	Avoidance, Minimization, and Mitigation Options	6-211
	6.7.2.3	Decommissioning	6-211
	6.7.2.3.1	Noise from Decommissioning	6-211
	6.7.2.3.2	Vessel Traffic	6-213
	6.7.2.3.3	Avoidance, Minimization, and Mitigation Options	6-213
	6.7.2.4	Conclusions	6-213
	6.7.2.5	Mitigation/BMPs	6-216
6.8		Sea Turtles	6-217
	6.8.1	Description of the Affected Environment	6-221
	6.8.2	Potential Impacts of the Project	6-230
	6.8.2.1	Construction and Installation	6-236
	6.8.2.1.1	Noise from Construction and Installation	6-236
	6.8.2.1.2	Vessel Traffic	6-240
	6.8.2.1.3	Avoidance, Minimization, and Mitigation Measures	6-241

TABLE OF CONTENTS (Continued)

6.8.2.2	Operations and Maintenance	6-242
6.8.2.2.1	Noise from Operations and Maintenance	6-242
6.8.2.2.2	Vessel Traffic	6-243
6.8.2.2.3	Electromagnetic Fields (EMF)	6-244
6.8.2.2.4	Habitat modification	6-244
6.8.2.2.5	Avoidance, Minimization, and Mitigation Measures	6-245
6.8.2.3	Decommissioning	6-245
6.8.2.3.1	Noise from Decommissioning	6-245
6.8.2.3.2	Vessel Traffic	6-246
6.8.2.3.3	Avoidance, Minimization, and Mitigation Measures	6-246
6.8.2.4	Conclusions	6-247
6.8.2.5	Mitigation/BMPs	6-247
7.0	SOCIOECONOMIC RESOURCES	7-1
7.1	Demographics and Employment, and Economics	7-1
7.1.1	Description of the Affected Environment	7-1
7.1.1.1	Massachusetts	7-1
7.1.1.1.1	Barnstable County	7-2
7.1.1.1.2	Bristol County	7-6
7.1.1.1.3	Dukes County	7-9
7.1.1.1.4	Nantucket County	7-11
7.1.1.2	Rhode Island	7-14
7.1.1.2.1	Providence County	7-14
7.1.1.2.2	Washington County	7-17
7.1.2	Potential Impacts of the Project	7-19
7.1.2.1	Construction and Installation	7-20
7.1.2.1.1	Workforce Impacts	7-21
7.1.2.1.2	Economic Impacts	7-22
7.1.2.1.3	Avoidance, Minimization, and Mitigation Measures	7-23
7.1.2.2	Operations and Maintenance	7-24
7.1.2.2.1	Workforce Impacts	7-24
7.1.2.2.2	Economic Impacts	7-25
7.1.2.2.3	Avoidance, Minimization, and Mitigation Measures	7-25
7.1.2.3	Decommissioning	7-25
7.1.2.3.1	Workforce Impacts	7-26
7.1.2.3.2	Economic Impacts	7-26
7.1.2.3.3	Mitigation Measures	7-26

TABLE OF CONTENTS (Continued)

7.2	Environmental Justice / Minority and Lower Income Groups/Subsistence Resources	7-26
7.2.1	Description of the Affected Environment	7-28
7.2.1.1	Massachusetts	7-28
7.2.1.2	Rhode Island	7-30
7.2.2	Potential Impacts of the Project	7-35
7.2.2.1	Construction and Installation	7-35
7.2.2.1.1	Impacts to Environmental Justice Populations	7-35
7.2.2.1.2	Avoidance, Minimization and Mitigation Measures	7-36
7.2.2.2	Operations and Maintenance	7-36
7.2.2.2.1	Impacts to Environmental Justice Populations	7-37
7.2.2.2.2	Avoidance, Minimization, and Mitigation Measures	7-37
7.2.2.3	Decommissioning	7-37
7.2.2.3.1	Impacts to Environmental Justice Communities	7-37
7.2.2.3.2	Avoidance, Minimization, and Mitigation Measures	7-38
7.3	Cultural, Historical, and Archaeological Resources	7-38
7.4	Visual Resources	7-40
7.5	Recreation and Tourism (including recreational fishing)	7-42
7.5.1	Description of the Affected Environment	7-42
7.5.1.1	Massachusetts	7-44
7.5.1.2	Rhode Island	7-46
7.5.2	Potential Impacts of the Project	7-46
7.5.2.1	Construction and Installation	7-47
7.5.2.1.1	Impacts to Recreational Resources	7-47
7.5.2.1.2	Impacts to Recreational Boating and Fishing	7-48
7.5.2.1.3	Avoidance, Minimization, and Mitigation Measures	7-49
7.5.2.2	Operations and Maintenance	7-50
7.5.2.2.1	Impacts to Recreational Resources	7-50
7.5.2.2.2	Impacts to Recreational Boating and Fisheries	7-50
7.5.2.2.3	Avoidance, Minimization, and Mitigation Measures	7-51
7.5.2.3	Decommissioning	7-51
7.5.2.3.1	Impacts to Recreational Resources	7-51
7.5.2.3.2	Impacts to Recreational Fisheries	7-51
7.5.2.3.3	Avoidance, Minimization, and Mitigation Measures	7-52

TABLE OF CONTENTS (Continued)

7.6.1	Description of the Affected Environment	7-54
7.6.1.1	Massachusetts Commercial Fishing Ports	7-55
	7.6.1.1.1 Near-Shore Commercial Shellfish Resources	7-56
7.6.1.2	Rhode Island Commercial Fishing Ports	7-57
7.6.1.3	Connecticut Commercial Fishing Ports	7-60
7.6.1.4	New York Commercial Fishing Ports	7-61
7.6.1.5	New Jersey Commercial Fishing Ports	7-61
7.6.1.6	Fisheries Management	7-62
7.6.2	Baseline “Without Project” Economic Value of Fishing Activity	7-63
7.6.2.1	Commercial Fishing Data Sources	7-63
7.6.2.2	Baseline Fishing Activity in the Offshore Project Area	7-68
7.6.2.3	Baseline Economic Value of Fishing Activity in the Massachusetts Wind Energy Area	7-94
7.6.2.4	Baseline Economic Value of Fishing Activity in the Vineyard Wind Lease Area	7-98
7.6.3	Fishery Impacts in and Around the Wind Development Area	7-123
7.6.3.1	Impacts on Fishing Activity Within the WDA	7-131
7.6.3.2	Impacts to Fishing Activities Outside the Wind Development Area (WDA)	7-133
7.6.3.3	Potential Impacts to Port Facilities	7-136
7.6.3.4	Avoidance, Minimization, and Mitigation Measures	7-136
7.6.4	Summary	7-138
7.6.5	For-Hire Recreational Fishing	7-140
7.6.5.1	Impacts to For-Hire Recreational Fisheries	7-141
7.7	Land Use and Coastal Infrastructure	7-142
7.7.1	Description of the Affected Environment	7-142
7.7.1.1	Massachusetts	7-142
	7.7.1.1.1 Barnstable County	7-142
	7.7.1.1.2 Bristol County	7-149
	7.7.1.1.3 Dukes County	7-153
7.7.1.2	Rhode Island	7-156
	7.7.1.2.1 Providence County	7-156
	7.7.1.2.2 Washington County	7-158
7.7.2	Potential Impacts of the Project	7-161
7.7.2.1	Construction and Installation	7-161
	7.7.2.1.1 Impacts to Land Use	7-162
	7.7.2.1.2 Impacts to Coastal Infrastructure	7-163
	7.7.2.1.3 Avoidance, Minimization, and Mitigation Measures	7-163

TABLE OF CONTENTS (Continued)

	7.7.2.2	Operations and Maintenance	7-163
	7.7.2.2.1	Impacts to Land Use	7-163
	7.7.2.2.2	Impacts to Coastal Infrastructure	7-163
	7.7.2.2.3	Avoidance, Minimization, and Mitigation Measures	7-164
	7.7.2.3	Decommissioning	7-164
	7.7.2.3.1	Impacts to Land Use	7-164
	7.7.2.3.2	Impacts to Coastal Infrastructure	7-164
	7.7.2.3.3	Avoidance, Minimization, and Mitigation Measures	7-164
7.8		Navigation and Vessel Traffic	7-164
	7.8.1	Description of the Affected Environment	7-165
	7.8.1.1	Navigation	7-165
	7.8.1.2	Commercial Vessel Traffic	7-166
	7.8.2	Potential Impacts of the Project	7-167
	7.8.2.1	Construction and Installation	7-167
	7.8.2.1.1	Impacts to Navigation	7-172
	7.8.2.1.2	Impacts to Commercial Vessel Traffic	7-174
	7.8.2.1.3	Avoidance, Minimization, and Mitigation Measures	7-175
	7.8.2.2	Operations and Maintenance	7-176
	7.8.2.2.1	Impacts to Navigation	7-179
	7.8.2.2.2	Impacts to Commercial Vessel Traffic	7-179
	7.8.2.2.3	Avoidance, Minimization, and Mitigation Measures	7-180
	7.8.2.3	Decommissioning	7-180
	7.8.2.3.1	Impacts to Navigation	7-181
	7.8.2.3.2	Impacts to Commercial Vessel Traffic	7-181
	7.8.2.3.3	Avoidance, Minimization, and Mitigation Measures	7-181
7.9		Other Uses (Marine Minerals, Military Use, Aviation, Offshore Energy)	7-181
	7.9.1	Description of the Affected Environment	7-181
	7.9.1.1	National Security	7-181
	7.9.1.2	Aviation and Air Traffic	7-183
	7.9.1.3	Offshore Energy	7-183
	7.9.1.4	Sand and Marine Mineral Extraction	7-184
	7.9.1.5	Cable and Pipelines	7-184
	7.9.1.6	Radar Systems	7-185

TABLE OF CONTENTS (Continued)

7.9.2	Potential Impacts of the Project	7-186
7.9.2.1	Construction and Installation	7-186
7.9.2.1.1	National Security	7-187
7.9.2.1.2	Aviation and Air Traffic	7-187
7.9.2.1.3	Offshore Energy	7-194
7.9.2.1.4	Sand and Mineral Extraction	7-194
7.9.2.1.5	Cable and Pipeline	7-194
7.9.2.1.6	Radar Systems	7-194
7.9.2.1.7	Avoidance, Minimization, and Mitigation Measures	7-195
7.9.2.2	Operations and Maintenance	7-195
7.9.2.2.1	National Security	7-195
7.9.2.2.2	Aviation and Air Traffic	7-196
7.9.2.2.3	Offshore Energy	7-196
7.9.2.2.4	Sand and Mineral Extraction	7-196
7.9.2.2.5	Cable and Pipeline	7-196
7.9.2.2.6	Radar Systems	7-196
7.9.2.2.7	Avoidance, Minimization, and Mitigation Measures	7-197
7.9.2.3	Decommissioning	7-197
7.9.2.3.1	National Security	7-197
7.9.2.3.2	Aviation and Air Traffic	7-197
7.9.2.3.3	Offshore Energy	7-197
7.9.2.3.4	Sand and Mineral Extraction	7-197
7.9.2.3.5	Cable and Pipeline	7-197
7.9.2.3.6	Radar Systems	7-197
7.9.2.3.7	Avoidance, Minimization, and Mitigation Measures	7-198
8.0	LOW PROBABILITY EVENTS	8-1
8.1	Collisions and Allisions	8-1
8.2	Spills	8-1
8.3	Severe Weather and Natural Events	8-2
8.4	Other Accidental Releases	8-2
9.0	REFERENCES	9-1

List of Appendices

Appendix III-A	Hydrodynamic and Sediment Dispersion Modeling Study
Appendix III-B	Air Emissions Calculations and Methodology
Appendix III-C	Avian Appendix
Appendix III-D	Benthic Habitat Monitoring Plan
Appendix III-E	Fisheries Communication Plan
Appendix III-F	Essential Fish Habitat Impact Assessment
Appendix III-G	Terrestrial Archaeology Resources Reports and Permits
Appendix III-H.a	Vineyard Wind Project Visual Impact Assessment
Appendix III-H.b	Vineyard Wind Project Historic Properties Visual Impact Assessment
Appendix III-I	Navigational Risk Assessment
Appendix III-J	Aviation Impact Assessment
Appendix III-K	Scour Potential Evaluation at Vineyard Wind
Appendix III-L	Economic Analysis
Appendix III-M	Supplemental Information for the Assessment of Potential Impacts to Marine Mammals and Sea Turtles During Construction, Operation, and Decommissioning of the Vineyard Wind Project
Appendix III-N	Frequency of Activation of an Aircraft Detection System Lighting System (ADLS) Report
Appendix III-O	Vineyard Wind Spring Tern Survey
Appendix III-P	Coastal Zone Management Act Consistency
Appendix III-Q	Community and Environmental Benefits of the Vineyard Wind Project
Appendix III-R	Proposed Mitigation to Facilitate East-West Fishing in the Wind Development Area

List of Figures

Figure 5.1-1	Background Air Quality	5-3
Figure 5.2-1	Locations of Water Quality Data Used from Center for Coastal Studies Stations (Circled)	5-20
Figure 5.2-2	Locations of Water Quality Data Used from NEFSC Trawls (1948-2014)	5-22
Figure 5.2-3	Locations of NOAA NBDC Buoys (Circled)	5-24
Figure 5.2-4	Locations of EPA NCCA Stations for Northeastern US (Left) and Nantucket Sound (Right)	5-25
Figure 5.2-5	Location of Project Components for Dispersion Modeling	5-30
Figure 5.2-6	Time-Integrated Maximum TSS Concentration for Inter-Array Cable Installation Using Typical Burial Parameters with Plan View (Lower Panel) and Vertical Section View (Upper Panel)	5-32
Figure 5.2-7	Plan View of Deposition Thickness for Inter-Array Cable Installation Using Typical Burial Parameters	5-33
Figure 5.2-8	Time-Integrated Maximum TSS Concentration for Inter-Array Cable Installation Using Maximum Impact Burial Parameters with Plan View (Lower Panel) and Vertical Section View (Upper Panel)	5-35
Figure 5.2-9	Plan View of Deposition Thickness for Inter-Array Cable Installation Using Maximum Impact Burial Parameters	5-36
Figure 5.2-10	Time-Integrated Maximum TSS Concentration Associated with Dredging, Overflow and Disposal for EM to NH Avenue OEEC Using Typical Burial Parameters with Plan View (Lower Panel) and Vertical Section View (Upper Panel).	5-40
Figure 5.2-11	Plan View of Deposition Thickness Associated with Dredging, Overflow and Disposal for EM to NH Avenue OEEC Using Typical Burial Parameters	5-41
Figure 5.2-12	Time-Integrated Maximum TSS Concentration Associated with Cable Installation of One Cable for EM to NH Avenue OEEC Using Typical Burial Parameters with Plan View (Lower Panel) and Vertical Section View (Upper Panel)	5-43
Figure 5.2-13	Plan View of Deposition Thickness Associated with Cable Installation of One Cable for EM to NH Avenue OEEC Using Typical Burial Parameters	5-44
Figure 5.2-14	Time-Integrated Maximum TSS Concentration Associated with Cable Installation of One Cable for EM to NH Avenue OEEC Using Maximum Impact Burial Parameters with Plan View (Lower Panel) and Vertical Section View (Upper Panel)	5-45
Figure 5.2-15	Plan View of Deposition Thickness Associated with Cable Installation of One Cable for EM to NH Avenue OEEC Using Maximum Impact Burial Parameters	5-47
Figure 6.1-1	Wetlands Proximate to the Onshore Export Cable Route (New Hampshire Avenue Landfall Sites)	6-4
Figure 6.1-2	Wetlands Proximate to the Onshore Export Cable Route (Covell's Beach Landfall)	6-5
Figure 6.4-1	Eelgrass Locations	6-85
Figure 6.5-1	Locations of Observed Deep-sea Coral in the Offshore Project Area (NOAAc, 2017)	6-89

List of Figures (Continued)

Figure 6.5-2	NOAA NCCOS Logistic Habitat Suitability Indices for Soft Coral (Alcyonacea), Hard Coral (Scleractinia) and Sea Pens (Pennatulacea)	6-90
Figure 6.5-3	Benthic Sampling Locations in and Surrounding the Wind Development Area	6-92
Figure 6.5-4	2014 NEFSC Shipboard Habitat Survey Grab Sample Catch by Percentage of Total Catch Numbers, Color-coded by Major Taxonomic Group	6-94
Figure 6.5-5	Sea Scallops Numbers Caught by NEFSC Seasonal Trawl Survey: 2003-2016 (Guida, 2017)	6-97
Figure 6.5-6	American Lobster Numbers Caught by NEFSC Fall & Spring Trawl Surveys: 2003-2016 (Guida 2017)	6-99
Figure 6.5-7	Natural Log-transformed Biomass (kg) per Tow for MA DMF and NEFSC Fall Sampling of Horseshoe Crab, Jonah Crab and Atlantic Lobster (NEODP, 2017)	6-100
Figure 6.5-8	Locations of Artificial Reefs in Relation to Two Potential Landfall Sites for the Project's Export Cables (NEODP, 2017)	6-101
Figure 6.5-9	Suitable Shellfish Habitat Along the Offshore Export Cable Corridor in Massachusetts State Waters Only (NEODP, 2017)	6-103
Figure 6.5-10	Suitable Shellfish Habitat In the Vicinity of the Two Potential Landfall Sites of the Offshore Export Cable Corridor (NEODP, 2017)	6-104
Figure 6.6-1	Expected Species Richness of the Fish Captured in Fall NEFSC Bottom Trawl Surveys (NEODP, 2017)	6-124
Figure 6.6-2	Expected Biomass of the Fish Captured in Fall NEFSC Bottom Trawl Surveys (NEODP, 2017)	6-125
Figure 6.6-3	Expected Forage Fish Biomass and Individual Biomass for Butterfish, Round Herring, and Atlantic Herring Captured in Fall NEFSC Bottom Trawl Surveys (NEODP, 2017)	6-126
Figure 6.6-4	Demersal Fish Biomass and Individual Biomass for Little Skate, Silver Hake, and Summer Flounder Captured in Fall NEFSC Bottom Trawl Surveys (NEODP, 2017)	6-127
Figure 6.6-5	Biomass (natural log) of Commonly Caught fish in the MA DMF Fall Trawl Surveys (2005-2014). Species included: Scup, Butterfish, Little Skate, Black Sea Bass (NEODP, 2017).	6-128
Figure 6.6-6	Average Abundance of Benthic Invertebrates Observed in SMAST Video Surveys from 2003-2012 (SMAST, 2016)	6-135
Figure 6.6-7	Average Percent of Samples with Sand Dollars, Sponges, or Bryozoans and Hydrozoans in SMAST Video Surveys from 2003-2012 (SMAST, 2016)	6-136
Figure 6.6-8	Longfin Squid and Egg Mop Catch Data from MDMF Bottom Trawl Spring Surveys (2007-2017)	6-137
Figure 6.6-9	Longfin Squid and Egg Mop Catch Data from MDMF Bottom Trawl Fall Surveys (2007-2017)	6-138
Figure 6.7-1a	North Atlantic Right Whale Monthly Aerial Survey Sightings per Unit Effort 2011 to 2015 from Kraus et al. (2016) January to June	6-154

List of Figures (Continued)

Figure 6.7-1b	North Atlantic Right Whale Monthly Aerial Survey Sightings per Unit Effort 2011 to 2015 from Kraus et al. (2016) July to December	6-155
Figure 6.7-2	North Atlantic Right Whale Biologically Important Area for Migration March to April and November to December	6-167
Figure 6.7-3	Fin Whale Seasonal Aerial Survey Sightings per Unit Effort from Kraus et al., (2016) October 2011 to June 2015	6-169
Figure 6.7-4	Sei Whale Seasonal Aerial Survey Sightings per Unit Effort from Kraus et al., (2016) October 2011 to June 2015	6-171
Figure 6.7-5	Sperm Whale Aerial Survey Sightings from Kraus et al., (2016) October 2011 to June 2015	6-174
Figure 6-7-6	Major Haul-Outs of Harbor Seals and Pupping Locations of Gray Seals near WDA and Offshore ECC	6-186
Figure 6.8-1	All Sea Turtles Seasonal Aerial Survey Sightings per Unit Effort from Kraus et al., (2016) October 2011 to June 2015	6-218
Figure 6.8-2	Loggerhead Turtle Seasonal Aerial Survey Sightings per Unit Effort from Kraus et al., (2016) October 2011 to June 2015	6-225
Figure 6.8-3	Leatherback Turtle Seasonal Aerial Survey Sightings per Unit Effort from Kraus et al., (2016) October 2011 to June 2015	6-229
Figure 7.1-1	Barnstable County, Massachusetts	7-3
Figure 7.1-2	Bristol County, Massachusetts	7-7
Figure 7.1-3	Dukes County, Massachusetts	7-10
Figure 7.1-4	Nantucket County, Massachusetts	7-12
Figure 7.1-5	Providence County, Rhode Island	7-15
Figure 7.1-6	Washington County, Rhode Island	7-18
Figure 7.2-1	Environmental Justice Communities, Barnstable, Massachusetts	7-31
Figure 7.2-2	Environmental Justice Communities, New Bedford, Massachusetts	7-32
Figure 7.2-3	Environmental Justice Communities, Martha’s Vineyard, Massachusetts	7-33
Figure 7.2-4	Environmental Justice Communities, Washington County, Rhode Island	7-34
Figure 7.6-1	Yarmouth Shellfish Propagation Areas	7-58
Figure 7.6-2	Craigville Beach Shellfish Closures	7-59
Figure 7.6-3	Massachusetts Ocean Management Plan, High Commercial Fishing Effort and Value	7-64
Figure 7.6-4	NROC – (VMS) Northeast Multispecies 2015-2016 (< 4 knots) Commercial Fishing Density	7-70
Figure 7.6-5	NROC – (VMS) Monkfish 2015-2016 (< 4 knots) Commercial Fishing Density	7-72
Figure 7.6-6	NROC – (VMS) Scallop 2015-2016 (< 5 knots) Commercial Fishing Density	7-73
Figure 7.6-7	NROC – (VMS) Surfclam/Ocean Quahog 2015-2016 (< 4 knots) Commercial Fishing Density	7-74
Figure 7.6-8	NROC – (VMS) Squid 2015-2016 (< 4 knots) Commercial Fishing Density	7-72
Figure 7.6-9	NROC – (VMS) Mackerel 2015-2016 (< 4 knots) Commercial Fishing Density	7-76

List of Figures (Continued)

Figure 7.6-10	NROC – (VMS) Herring 2015-2016 (< 4 knots) Commercial Fishing Density	7-77
Figure 7.6-11	MARCO – (VTR) Bottom Trawl (Vessels < 65 ft.) 2006 - 2010	7-79
Figure 7.6-12	MARCO – (VTR) Bottom Trawl (Vessels < 65 ft.) 2011 - 2015	7-80
Figure 7.6-13	MARCO – (VTR) Bottom Trawl (Vessel > 65 ft.) 2006 - 2010	7-82
Figure 7.6-14	MARCO – (VTR) Bottom Trawl (Vessel > 65 ft.) 2011 - 2015	7-83
Figure 7.6-15	MARCO – (VTR) Dredge 2006 - 2010	7-84
Figure 7.6-16	MARCO – (VTR) Dredge 2011 - 2015	7-85
Figure 7.6-17	MARCO – (VTR) Gillnet 2006 – 2010	7-86
Figure 7.6-18	MARCO – (VTR) Gillnet 2011 – 2015	7-87
Figure 7.6-19	MARCO – (VTR) Longline 2006 – 2010	7-88
Figure 7.6-20	MARCO – (VTR) Longline 2011 – 2015	7-88
Figure 7.6-21	MARCO – (VTR) Pots and Traps 2006 – 2010	7-89
Figure 7.6-22	MARCO – (VTR) Pots and Traps 2011 – 2015	7-90
Figure 7.6-23	Massachusetts DMF Statistical Reporting Areas	7-91
Figure 7.6-24	DEM – Squid, Mackerel, Butterfish 2011 Commercial Fishing Density	7-102
Figure 7.6-25	DEM – Squid, Mackerel, Butterfish 2012 Commercial Fishing Density	7-103
Figure 7.6-26	DEM – Squid, Mackerel, Butterfish 2013 Commercial Fishing Density	7-104
Figure 7.6-27	DEM – Squid, Mackerel, Butterfish 2014 Commercial Fishing Density	7-105
Figure 7.6-28	DEM – Squid, Mackerel, Butterfish 2015 Commercial Fishing Density	7-106
Figure 7.6-29	DEM – Squid, Mackerel, Butterfish 2016 Commercial Fishing Density	7-107
Figure 7.6-30	DEM – Squid, Mackerel, Butterfish 2011-2016 Commercial Fishing Density	7-108
Figure 7.6-31	DEM – Sea Scallop 2011 Commercial Fishing Density	7-109
Figure 7.6-32	DEM – Sea Scallop 2012 Commercial Fishing Density	7-110
Figure 7.6-33	DEM – Sea Scallop 2013 Commercial Fishing Density	7-111
Figure 7.6-34	DEM – Sea Scallop 2014 Commercial Fishing Density	7-112
Figure 7.6-35	DEM – Sea Scallop 2015 Commercial Fishing Density	7-113
Figure 7.6-36	DEM – Sea Scallop 2016 Commercial Fishing Density	7-114
Figure 7.6-37	DEM - Scallop 2011-2016 Commercial Fishing Density	7-115
Figure 7.6-38	DEM – Northeast Multispecies 2011 Commercial Fishing Density	7-116
Figure 7.6-39	DEM – Northeast Multispecies 2012 Commercial Fishing Density	7-117
Figure 7.6-40	DEM – Northeast Multispecies 2013 Commercial Fishing Density	7-118
Figure 7.6-41	DEM – Northeast Multispecies 2014 Commercial Fishing Density	7-119
Figure 7.6-42	DEM – Northeast Multispecies 2015 Commercial Fishing Density	7-120
Figure 7.6-43	DEM – Northeast Multispecies 2016 Commercial Fishing Density	7-121
Figure 7.6-44	DEM - Northeast Multispecies 2015-2016 Commercial Fishing Density	7-122
Figure 7.6-45	DEM – Monkfish 2011 Commercial Fishing Density	7-124
Figure 7.6-46	DEM – Monkfish 2012 Commercial Fishing Density	7-125
Figure 7.6-47	DEM – Monkfish 2013 Commercial Fishing Density	7-126
Figure 7.6-48	DEM – Monkfish 2014 Commercial Fishing Density	7-127
Figure 7.6-49	DEM – Monkfish 2015 Commercial Fishing Density	7-128
Figure 7.6-50	DEM – Monkfish 2016 Commercial Fishing Density	7-129

List of Figures (Continued)

Figure 7.6-51	DEM - Monkfish 2011-2016 Commercial Fishing Density	7-130
Figure 7.6-52	Estimated Range from Selected Ports to Fishing Grounds	7-134
Figure 7.7-1	Land Use, Barnstable	7-145
Figure 7.7-2	Land Use, Yarmouth	7-148
Figure 7.7-3	Land Use, New Bedford	7-151
Figure 7.7-4	Land Use, Martha's Vineyard	7-155
Figure 7.7-5	Land Use - City of Providence, Rhode Island	7-157
Figure 7.7-6	Land Use - Town of North Kingstown, Rhode Island	7-160
Figure 7.8-1	2013 Cargo Vessel Density	7-168
Figure 7.8-2	2013 Passenger Vessel Density	7-169
Figure 7.8-3	2013 Tug-Tow Vessel Density	7-170
Figure 7.8-4	2013 Tanker Vessel Density	7-171
Figure 7.9-1	Preliminary Screening Tool Analysis	7-193

List of Tables

Table 2.1-1	Vineyard Wind Project Envelope with Maximum Design Scenario	2-2
Table 2.2-1	WTG Parameters	2-5
Table 3-1	Universe of Cable Route Options (all lengths approximate, miles)	3-9
Table 4.2-1	Summary of Potential Impacts and Avoidance, Minimization, and Mitigation Measures	4-5
Table 4.2-2	BOEM's Best Management Practices	4-22
Table 5.1-1	National (NAAQS) and Massachusetts (MAAQS) Ambient Air Quality Standards	5-2
Table 5.1-2	Air Quality Designations for Areas Where Project-Related Emissions May Occur	5-5
Table 5.1-3	Total Emissions from US Commercial Marine Traffic, 2014	5-6
Table 5.1-4	Impact-producing Factors for Air Quality	5-7
Table 5.1-5	Maximum Air Emissions During Construction	5-10
Table 5.1-6	Maximum NO _x Emissions During Construction (tpy)	5-14
Table 5.1-7	Air Emissions During Operations and Maintenance (O&M)	5-16
Table 5.1-8	Avoided Air Emissions in New England	5-16
Table 5.2-1	Minimum, Mean, and Maximum Values of Water Quality Parameters Reported in Nantucket Sound by the CCS for the period 2010-2016	5-21
Table 5.2-2	Mean and Standard Deviation for Seasonal (Spring, Fall, and Winter only) Temperature and Salinity Data from the NEFSC Multispecies Bottom Trawl Survey	5-23
Table 5.2-3	Mean Seasonal Surface Temperature Data from the NOAA NDBC Buoys 44020 and 44097 for the Period 2009-2016	5-23
Table 5.2-4	Impact-Producing Factors for Water Quality	5-28
Table 5.2-5	Maximum Extents and Duration Areas for Representative Inter-Array Cable for Typical and Maximum Impact Installation Parameters	5-34
Table 5.2-6	Maximum Extents and Duration Areas for the Four OECC Variants for Four Activities with Typical Installation Parameters and a Comparative Maximum Impact	5-48
Table 5.3-1	Impact-producing Factors on Site Geology	5-57
Table 6.1-1	Amphibians and Reptiles Confirmed on Massasoit Wildlife Refuge, Plymouth, MA	6-7
Table 6.1-2	Birds Confirmed at Massasoit Wildlife Refuge, Plymouth, MA	6-9
Table 6.1-3	Mammals Confirmed at Massasoit Wildlife Refuge, Plymouth, MA	6-19
Table 6.1-4	Invertebrates Confirmed at Massasoit Wildlife Refuge, Plymouth, MA	6-21
Table 6.1-5	Impact-Producing Factors for Terrestrial Wildlife	6-23
Table 6.2-1	Definition of Exposure Levels	6-29
Table 6.2-2	Shorebirds Listed in Massachusetts and their Federal Status	6-30

List of Tables (Continued)

Table 6.2-3	Waterbirds Listed in Massachusetts and their Federal Status	6-31
Table 6.2-4	Raptors Listed in Massachusetts and their Federal Status	6-33
Table 6.2-5	Songbirds Listed in Massachusetts and their Federal Status	6-34
Table 6.2-6	Basic Ecological Traits of Marine Birds in the Region and Their Conservation Status at State, Federal, and Global Scales ¹	6-38
Table 6.2-7	Definitions Behavioral Vulnerability	6-48
Table 6.2-8	Impact- Producing Factors for Birds	6-49
Table 6.2-9	Summary of Potential Impacts to Birds During Construction in the Offshore Project Area and Mitigation Actions	6-54
Table 6.2-10	Summary of Potential Impacts to Birds in the WDA during Operation and Mitigation Actions	6-72
Table 6.3-1	Bat Species Present in Massachusetts and their Conservation Status	6-75
Table 6.3-2	Definitions of Exposure Levels.	6-77
Table 6.3-3	Impact- Producing Factors for Bats	6-81
Table 6.4-1	Impact-Producing Factors for Coastal Habitat	6-84
Table 6.5-1	Seasonal Results of SMAST Video Survey Samples Collected in Wind Development Area in May 2012 and September 2013 (107 samples from 9 locations)	6-91
Table 6.5-2	Beam Trawl Summary for Epibenthic and Demersal Fauna within the Massachusetts WEA (23 trawls, 59 taxa)	6-93
Table 6.5-3	Catch Numbers of Atlantic Surf Clam and Ocean Quahog in NOAA Fisheries Service-NEFSC Surfclam/Ocean Quahog Survey at Sampling Locations in Vicinity of the WDA (NEFSC, 2018)	6-96
Table 6.5-4	Impact-Producing Factors for Benthic Resources	6-106
Table 6.5-5	Vineyard Wind Maximum Area of Seafloor Impacts	6-116
Table 6.6-1	Major Fish and Invertebrate Species Potentially Occurring in the Project Area (BOEM, 2014)	6-122
Table 6.6-2	List of Northeast Atlantic Threatened and Endangered Species and Species of Special Concern with ranges that may overlap the BOEM Massachusetts Wind Energy Area (BOEM, 2014)	6-132
Table 6.6-3	Impact- producing Factors for Finfish and Invertebrates	6-139
Table 6.7-1	Marine Mammals that Potentially Occur in the WDA and OECC: Abundance, Status, Distribution, and Occurrence	6-162
Table 6.7-2	Potential Impact-producing Factors for Marine Mammals	6-190
Table 6.7-3	Definitions of Risk, Exposure, and Vulnerability for Marine Mammals	6-191
Table 6.7-4	Marine Mammal Hearing Groups (see Appendix III-M Section 4.3.1)	6-197
Table 6.7-5	NOAA Injury Criteria for Marine Mammals	6-198
Table 6.8-1	Sea Turtles in the Wind Development Area and Offshore Export Cable Corridor: Status and Occurrence	6-223
Table 6.8-2	Potential Impact-producing Factors for Sea Turtles	6-232
Table 6.8-3	Definitions of Risk, Exposure, and Vulnerability for Sea Turtles	6-233

List of Tables (Continued)

Table 6.8-4	Hearing Ranges for Sea Turtles (all values are frequencies in Hz)	6-237
Table 6.8-5	Pile Driving Mortality and Recoverable Injury Thresholds for Sea Turtles	6-237
Table 7.1-1	Existing Economic Conditions in the Vicinity of Vineyard Wind	7-2
Table 7.1-2	Barnstable County Housing ¹	7-5
Table 7.1-3	Bristol County Housing ¹	7-8
Table 7.1-4	Dukes County Housing ¹	7-11
Table 7.1-5	Nantucket County Housing ¹	7-13
Table 7.1-6	Existing Economic Conditions in the Vicinity of Vineyard Wind	7-14
Table 7.1-7	Providence County Housing ¹	7-16
Table 7.1-8	Washington County Housing ¹	7-19
Table 7.1-9	Impact-producing Factors for Employment and Economics	7-19
Table 7.2-1	Minority and Low Income Populations, Massachusetts	7-29
Table 7.2-2	Minority and Low Income Populations, Rhode Island	7-30
Table 7.2-3	Impact-producing Factors for Environmental Justice Communities	7-35
Table 7.5-1	Impact-producing Factors for Recreation and Tourism	7-47
Table 7.6-1	Number of fishing vessels in the WDA per month (AIS 2016/17 data)	7-68
Table 7.6-2	Massachusetts Annual Landings (live pounds) by Species in Statistical Reporting Area 10 (DMF)	7-82
Table 7.6-3	Massachusetts Annual Landings (live pounds) by Species in Statistical Reporting Area 12 (DMF)	7-93
Table 7.6-4	Average Annual Revenue from the MA Wind Energy Area by Fishery Management Plan (2007-2012, Kirkpatrick et al. 2017)	7-95
Table 7.6-5	Average Annual Revenue from the MA Wind Energy Area by Species 2007-2012, Kirkpatrick et al. 2017)	7-96
Table 7.6-6	Number of Permits and Revenue, by Gear, Exposed to Development of the MA Wind Energy Area, 2007–2012 (Kirkpatrick et al. 2017)	7-97
Table 7.6-7	Estimated Annual Landings from Lease Area by State (2011-2016; Livermore [2017])	7-99
Table 7.6-8	Estimated Annual Landings by Port (2011-2016; Livermore [2017])	7-100
Table 7.6-9	Estimated Annual Landings by Fishery Management Plan (2011-2016; Livermore [2017])	7-100
Table 7.6-10	Estimated Annual Landings by Gear Type (2011-2016; Livermore [2017])	7-101
Table 7.6-11	Estimated Transit Route Distances for Select Fishing Ports	7-135
Table 7.6-12	Estimated Annual Landings from Wind Development Area by State (2011-2016)	7-139
Table 7.7-1	Impact-producing Factors for Land Use and Coastal Infrastructure	7-161
Table 7.9-1	Impact-producing Factors for Other Uses	7-186

List of Acronyms

AC	Alternating current
ACS	American Community Survey
ADLS	Aircraft Detection Lighting System
AGL	Above ground level
AMAPPS	Atlantic Marine Assessment Program for Protected Species
AMSL	Above Mean Sea Level
AIS	Automatic Identification System
APE	Area of Potential Effect
AR	Avangrid Renewables
ASMFC	Atlantic State Marine Fisheries Commission
ATC	Air Traffic Control
ATON	Aids to Navigation
BACT	Best Available Control Technology
BIA	Biological Important Area
BLS	Bureau of Labor Statistics
BMP	Best Management Practices
BOEM	Bureau of Ocean Energy Management
°C	Degrees Celsius
CAD	Confined Aquatic Disposal
Call	Call for Information and Nominations
CBA	Community Benefit Agreement
CBP	County Business Patterns
CCC	Cape Cod Commission
CCS	Center for Coastal Studies
CEQ	Council on Environmental Quality
CFR	Code of Federal Regulations
CIP	Copenhagen Infrastructure Partners
CL	Carapace (i.e., shell) lengths
cm	Centimeters
CO	Carbon Monoxide
CO ₂	Carbon Dioxide
COA	Corresponding Onshore Area
COP	Construction and Operations Plan
CPT	Cone penetrometer test
CSV	Construction support vessel
CTV	Crew Transfer Vessel
CVA	Certified Verification Agent
cy	Cubic yard
dB	Decibels
DMF	Massachusetts Division of Marine Fisheries
DO	Dissolved Oxygen

List of Acronyms (Continued)

DoD	United States Department of Defense
DOE	United States Department of Energy
DOER	Massachusetts Department of Energy Resources
DP	Dynamically positioned
DPS	Distinct Population Segments
DPW	Department of Public Works
E	Endangered
E	Extensive
EA	Environmental Assessment
ECA	Emission Control Area
ECC	Export Cable Corridor
EEA	Executive Office of Energy and Environmental Affairs
EEZ	Exclusive Economic Zone
EFH	Essential Fish Habitat
eGRID	Environmental Protection Agency's Emissions & Generation Resource Integrated Database
EJ	Environmental Justice
EMF	Electromagnetic Field
ENF	Environmental Notification Form
EO	Executive Order
EPA	Environmental Protection Agency
ERC	Emission Reducing Credits
ERP	Environmental Results Program
ERP	Emergency Response Plan
ESA	Endangered Species Act
ESP	Electrical service platform
EU	European Union
EWB	New Bedford Regional Airport
f	Fall
°F	Degrees Fahrenheit
FAA	Federal Aviation Administration
FDR	Facilities Design Report
FIR	Fabrication and Installation Report
FL	Fishery Liaison
FMP	Fishery Management Plan
FNP	Federal Navigation Project
FONSI	Finding of No Significant Impact
FR	Fishery Representative
ft	Feet
ft ²	Square feet

List of Acronyms (Continued)

FTZ	Federal Trade Zone
G&G	Geophysical and geotechnical
gal	Gallons
GDP	Gross domestic product
G.L.	General Law
HAPs	Hazardous air pollutants
HDD	Horizontal directional drilling
HFO	Heavy fuel oils
HPWMA	Hyannis Ponds Wildlife Management Area
hr	Hour
HRG	High-resolution geophysical
HSE	Health, Safety and Environment
HVAC	High-voltage alternating current
HVDC	High-voltage alternating current
Hz	Hertz
IALA	International Association of Lighthouse Authorities
IEC	International Electrotechnical Commission
IFR	Instrument flight rules
IHA	Incidental Harassment Authorization
IMCA	International Marine Contractors Association
IMO	International Maritime Organization
IPF	Impact Producing Factor
ISO	Independent System Operator
kHz	KiloHertz
kJ	Kilojoules
km	Kilometers
km ²	Square kilometers
kV	kilovolt
L	Liters
L	Localized
LAER	Lowest Achievable Emission Rate
LOA	Letter of Authorization
Lpk	Peak sound pressure
LT	Long-term
m	Meters
m ²	Square meters
m ³	Cubic meters
MA	Massachusetts
Max	Maximum

List of Acronyms (Continued)

MAAQS	Massachusetts Ambient Air Quality Standards
MAFMC	Mid-Atlantic Fisheries Management Council
MA CZM	Massachusetts Coastal Zone Management
MA DEP	Massachusetts Department of Environmental Protection
MA DMF	Massachusetts Division of Marine Fisheries
MA EFSB	Massachusetts Energy Facility Siting Board
MA WEA	Massachusetts Wind Energy Area
MassCEC	Massachusetts Clean Energy Center
MassDFW	Massachusetts Division of Fisheries and Wildlife
MassDOT	Massachusetts Department of Transportation
MassGIS	Massachusetts Bureau of Geographic Information
MARPOL	Marine Pollution
MEPA	Massachusetts Environmental Policy Act
mg/L	Milligram per liter
$\mu\text{g/L}$	Microgram per liter
μm	Micromolar
μPa	MicroPascal
mi	Miles
MHC	Massachusetts Historic Commission
MLLW	Mean Lower Low Water
mm	Millimeters
mm^2	Square millimeters
MMPA	Marine Mammal Protection Act
MMS	Mineral Management Service
MP	Monopile
m/s	Meters per second
MSD	Marine sanitization device
MVA	Minimum vectoring altitude
MVC	Martha's Vineyard Commission
MVY	Martha's Vineyard Airport
MW	Megawatt
NAAQS	National Ambient Air Quality Standards
NRA	Navigational Risk Assessment
NUWC	Naval Undersea Warfare Center
NAICS	North American Industry Classification System
NARW	North Atlantic Right Whale
NBDC	National Data Buoy Center
NCCA	National Commission for Certifying Agencies
NEAMAP	Northeast Area Monitoring and Assessment Program

List of Acronyms (Continued)

NEFMC	New England Fisheries Management Council
NEFSC	Northeast Fisheries Science Center
NEXRAD	Next Generation Radar
NHESP	National Heritage and Endangered Species Program
NH DES	New Hampshire Department of Environmental Services
NJDEP	New Jersey Department of Environmental Protection
nm	Nautical miles
NMFS	National Marine Fisheries Service
No.	Number
NOAA	National Oceanic and Atmospheric Administration
NODEs	Density Estimates
NO ₂	Nitrogen Dioxide
NO _x	Nitrogen Oxide
NOI	Notice of Intent
NOTAMs	Notice to Airmen
NPDES	National Pollutant Discharge Elimination System
NRLM	Non-road, locomotive, or marine
NROC	Northeast Regional Ocean Council
NTMs	Notices to Mariners
NTU	Nephoelometric Turbidity Unit
NUWC	Naval Undersea Warfare Center
NWS	National Weather Service
O ₃	Ozone
O&M	Operations and Maintenance Facilities
OCS	outer continental shelf
OCSLA	Outer Continental Shelf Lands Act
OECC	Offshore Export Cable Corridor
OEM	Original Equipment Manufacturers
OPAREA	Navy Operation Area
OSP	Optimum Sustainable Population
OSRP	Oil Spill Response Plan
PAL	Public Archaeological Laboratory
PAM	Passive acoustic monitoring
PATON	Private aids to navigation
PAVE/PAWS	Precision Acquisition Vehicle Entry/Phased Array Warning System
PD	Pile driving
Pb	Lead
PEIS	Programmatic Environmental Impact Statement

List of Acronyms (Continued)

people/mi ²	People per square mile
PEP	Population Estimate Program
PM	Particulate matter
ppm	Parts per million
PSO	Protected species observer
psu	Practical Salinity Units
PTS	Permanent threshold shift
PVC	Polyvinyl chloride
RFI	Request for Interest
RFP	Request for Proposals
RI	Rhode Island
RI DEM	Rhode Island Department of Environmental Management
rms	Root mean squared
RNA	Rotor Nacelle Assembly
ROTV	Remotely operated towed vehicle
ROV	Remotely operated vehicle
ROW	Right-of-way
RPS ASA	Applied Science Associates, Inc.
RSD	ripple scour depressions
RTA	Regional Transit Authority
RV	Research vessel
s	Spring
SAP	Site Assessment Plan
SARs	Stock Assessment Reports
SCADA	Supervisory control and data acquisition
SD	Standard Deviation
SEFSC	Southeast Fisheries Science Center
SELcum	Cumulative sound exposure level
SMASST	University of Massachusetts School of Marine Science and Technology
SMS	Safety Management System
SO ₂	Sulfur dioxide
Sound	Nantucket Sound
SOV	Service Operations Vessel
SPUE	Sightings per unit effort
ST	Short-term
STSSN	Sea Turtle Stranding and Salvage Network
su	Summer
T	Threatened
TBD	To be determined
TBF	To be filed

List of Acronyms (Continued)

TDWR	Terminal Doppler Weather Radar
THPO	Tribal Historic Preservation Officer
TN	Total nitrogen
TNASS	Canadian Trans-North Atlantic Sighting Survey
TP	Total phosphorous
TP	Transition piece
tpy	Tons per year
TSHD	Trailing suction hopper dredge
TSS	Total suspended sediment
TSS	Traffic separation scheme
TTS	Temporary threshold shifts
Typ	Typical
u	Uncommon
US	United States
USACE	United States Army Corps of Engineers
USCG	United States Coast Guard
USCGC	United States Coast Guard Cutter
USDOE	United States Department of Energy
USDOI	United States Department of Interior
USFWS	United States Fish & Wildlife Service
Utility ROW	Utility Right of Way
VFR	Visual flight rules
VMS	Vessel Monitoring System
VOC	Volatile organic compounds
VT	Vessel Traffic
VTA	Vineyard Transit Authority
w	Winter
WDA	Wind Development Area
WEA	Wind Energy Area
WNS	White nose syndrome
WQI	Water Quality Index
WTG	Wind turbine generator
XLPE	Cross-linked polyethylene